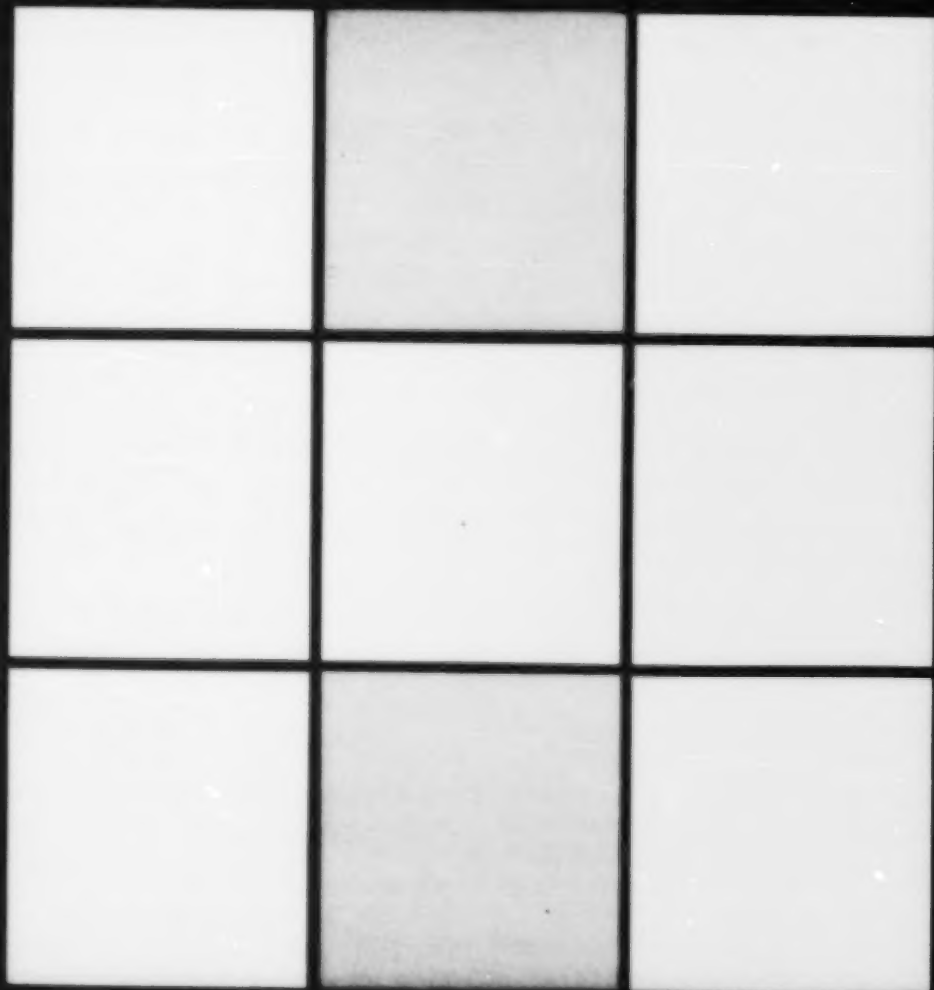


Pulmonary Function Laboratories, Guidelines



88-04243/

**REPORT OF THE WORKING GROUP
ON SPECIAL SERVICES IN HOSPITALS**

**GUIDELINES FOR ESTABLISHING STANDARDS
FOR SPECIAL SERVICES IN HOSPITALS**

**PULMONARY FUNCTION
LABORATORIES**

**Health Services Directorate
Health Services and Promotion Branch**

**Published by the authority of the
Minister of National Health and Welfare
1982**

**Également disponible en français sous le titre
"Guide regissant l'établissement
d'un laboratoire d'exploration
fonctionnelle respiratoire".**

I M P O R T A N T

The information contained in these Guidelines was current at the time of publication. When using the Guidelines it should be remembered that certain aspects of the delivery of health care and health technology are changing rapidly. Should you identify any out-of-date material in the text, please inform:

Mr. D.F. Moffatt,
Chairman, Sub-Committee on Special
Services in Hospitals,
Health Services Directorate,
Health Services and Promotion Branch,
Department of National Health and Welfare,
Ottawa, Ontario
K1A 1B4

Further copies of these Guidelines in both official languages can be obtained from the above person.

TABLE OF CONTENTS

	Page
GENERAL INTRODUCTION	v
LIST OF PARTICIPANTS	viii
PREAMBLE	1
GLOSSARY	3
GUIDELINES	
1. APPLICATIONS OF PULMONARY FUNCTION EVALUATION	6
2. BED REQUIREMENTS	7
3. MINIMUM PATIENT LOAD	8
4. ADMINISTRATION POLICY PROCEDURES AND CONTROL	8
5. STAFF ESTABLISHMENT AND COVERAGE	10
6. STAFF QUALIFICATIONS AND TRAINING	11
7. SPECIFIC SUPPORTING DEPARTMENTS AND SERVICES	13
8. SPACE ALLOCATION, UTILIZATION AND DESIGN FEATURES	14
9. EQUIPMENT	17
10. PHYSICAL RELATIONSHIPS WITH OTHER DEPARTMENTS	20

APPENDICES

APPENDIX I	Calibration and Quality control of Pulmonary Function Laboratory	22
APPENDIX II	Reference Values and Tables	29
APPENDIX III	Guidelines for Policies and Procedures for Special Services in Hospitals	36
APPENDIX IV	Guidelines for Special Services in Hospital	39

GENERAL INTRODUCTION

Background

Advances in health technology and changes in the planning and delivery of health care have contributed to an increasing demand for specialized care facilities and services in hospitals. A dramatic rise in the number of intensive and specialized care facilities and services in hospitals has occurred in recent decades due to rapid technological development in electronics and automation, and as a result of new approaches to patient care. These changes have produced demands for physical facilities, specialized equipment and highly-trained health manpower. Because of this, there is a continuing need for guidelines for standards to assist those involved in planning, organizing and operating special care services in hospitals.

Mandate

In 1972 health authorities in Canada recognized the need for guidance in this area, and the Federal-Provincial Advisory Committee on Health Insurance commissioned the Working Group on Special Services in Hospitals to create guidelines for standards to provide a reliable definition of requirements for a number of special care facilities and services.

Guidelines were developed by the Working Group for 14 units and services, and, in 1975, these were published under the title, "Guidelines for Special Care Units in Hospitals". This volume was widely distributed to provincial health and hospital authorities, and to national and international health organizations, and has been adopted by many as a guide.

The continuing development of existing and new health technologies, together with changes occurring in the pattern of health care delivery, gave impetus

to the updating of the 1975 Guidelines, and to the development of guidelines in additional areas. In May 1982, the Federal-Provincial Advisory Committee on Institutional and Medical Services granted the Working Group continuing status as a sub-committee of the Advisory Committee. The name of the Working Group was therefore changed to the Sub-Committee on Special Services in Hospitals. A complete list of Guidelines published or being prepared by the Sub-Committee is appended.

Methodology

The Guidelines published in 1975 were developed on the principle of a consensus of information, knowledge, experience and expert opinion obtained from appropriate organizations and individuals throughout Canada. They were based, where possible, on guidelines developed in Canada, and from authoritative sources in other countries. This approach has been generally acceptable to government and hospital authorities and the health professions.

The present Guidelines were prepared on a similar basis. On this occasion, in addition to input from provincial authorities, the expert opinion of health professionals was obtained through formally designated representatives of national health organizations representing the activities involved in each specific service. It is certain that many hundreds of health professionals from every area of the country have provided expert input in these Guidelines by this method, and have thus provided a truly Canadian consensus on these topics.

Suggested purpose of the Guidelines

The Guidelines should not be regarded as rigid standards. Their application may vary throughout Canada, and it is the prerogative of each province to accept, modify or reject the Guidelines according to provincial priorities.

The purpose of the Guidelines is to provide a definition of requirements for a number of special care facilities and services. They are not intended to provide standards for clinical practice.

Where development of a unit is under consideration, the Guidelines will assist planners and government health authorities in determining the need for such a unit, and in assessing the total potential impact of a new unit on existing and projected services, both at the local and regional levels. Deficiencies in existing services can be identified, and in some cases these can be corrected without the need to develop a new unit.

Where a unit already exists in a hospital, the Guidelines will help to identify problem areas related to administration, personnel, equipment, and physical facilities. They will help to determine necessary remedial action and to set priorities for corrective measures on the basis of clinical need, fiscal realities, and the degree to which a deficiency in the physical facilities impedes adequate functioning of the unit.

Future revisions

Because of the rapidly changing nature of health care, the Guidelines will require regular revision. It is planned to maintain the Sub-Committee to carry out this function.

Acknowledgments

The Sub-Committee acknowledges with sincere appreciation the immense amount of work undertaken and time given by practising health professionals in Canada in providing detailed written information and guidance in the preparation of these Guidelines. In addition, we wish to thank the many others who, in any way contributed advice and information to this endeavour.

LIST OF PARTICIPANTS

The membership of the Sub-Committee on Special Services in Hospitals, responsible for the preparation of the new and updated Guidelines, is as follows:

Mr. Donald F. Moffatt, Chairman
Director
Institutional and Professional Services
Division
Health Services Directorate
Health Services and Promotion Branch
Department of National Health and Welfare
OTTAWA, Ontario

Mr. Derek J. Beckley
Director
Program Planning Branch
Hospital Services
Alberta Hospitals and Medical Care
EDMONTON, Alberta

Mme Madeleine L. Côté
Chief, Institutional Health Services Section
Institutional and Professional Services
Division
Health Services Directorate
Health Services and Promotion Branch
Department of National Health and Welfare
OTTAWA, Ontario

Dr Maurice Héon
Professeur et directeur
Département de Neurochirurgie de la Faculté
de médecine de Sherbrooke
Centre Hospitalier de l'Université de
Sherbrooke
SHERBROOKE (Québec)

Dr. Gordon A. Judge
Medical Director
The Toronto Western Hospital
TORONTO, Ontario

Mrs. Phyllis MacDonald
Standards Officer
Urban Health Facilities Division
Manitoba Health Services Commission
WINNIPEG, Manitoba

Mr. David L. Martin
Consultant in Health Administration
Institutional and Professional Services
Division
Health Services Directorate
Health Services and Promotion Branch
Department of National Health and Welfare
OTTAWA, Ontario

Dr. Hans H. Rubarth
Consultant, Health Administration
Institutional and Professional
Services Division
Health Services Directorate
Health Services and Promotion Branch
Department of National Health and Welfare
OTTAWA, Ontario

Dr. Robert Seaver
Senior Medical Consultant
Personal Health Division
Program Advisory Branch
Ministry of Health
TORONTO, Ontario

SECRETARIAT

Mrs. Janet Stow
Project Manager
Institutional and Professional Services
Division
Health Services Directorate
Health Services and Promotion Branch
Department of National Health and Welfare
OTTAWA, Ontario

WORKING GROUP ON PULMONARY FUNCTION LABORATORIES

The guidelines for Pulmonary Function Laboratories contained in this volume were prepared for the Sub-Committee on Special Services in Hospitals by a Working Group which included members recommended by The Medical Section of the Canadian Lung Association, the Canadian Society of Pulmonary and Cardiovascular Technologists and the Canadian Society of Respiratory Technologists. The membership of this Working Group was as follows:

Dr. N.R. Anthonisen (Chairman)
Head, Section of Respiratory Diseases
Professor of Medicine
University of Manitoba
WINNIPEG, Manitoba

Dr. Manuel G. Cosio
Director, Pulmonary Laboratories Royal Victoria
Hospital
Associate Professor of Medicine
University McGill
MONTREAL, Quebec

Mme Madeleine L. Côté
Chief
Institutional Services
Institutional and Professional Services Division
Health Services and Promotion Branch
Health Services Directorate
Department of National Health and Welfare
OTTAWA, Ontario

Dr Marc Desmeules
Directeur, Centre de Pneumologie
Hôpital Laval
Professeur adjoint de médecine
Université de Laval
QUÉBEC, Québec

Dr. E.S. Hershfield
Executive Director
Canada Lung Association (Ottawa)
Associate Professor of Medicine
University of Manitoba
WINNIPEG, Manitoba

Ms. Michèle Leroux
Past President
Canadian Society of Pulmonary and
Cardiovascular Technologists
Chief Technologist, Pulmonary Function
Laboratories
Mount Sinai, Toronto General, and Women's
College Hospitals
TORONTO, Ontario

Dr. John L.C. Morse
Director, Pulmonary Function Laboratories
St. Joseph's Hospital
Associate Professor of Medicine
McMaster University
HAMILTON, Ontario

Dr. David Ostrow
Assistant Professor
University of British Columbia
VANCOUVER, British Columbia

Dr. Réal G. Préfontaine
Medical Advisor
Institutional and Professional Services Division
Health Services Directorate
Health Services and Promotion Branch
Department of National Health and Welfare
OTTAWA, Ontario

Mr. Keith Wilson, R.R.T.
Technical Director Pulmonary Function
Laboratories
Royal Alexandra Hospital
EDMONTON, Alberta

Dr. Noe Zamel
Director, Pulmonary Function Laboratories
Mount Sinai, Toronto General, Women's College
Hospitals
Professor of Medicine
University of Toronto
TORONTO, Ontario

P R E A M B L E

A pulmonary function laboratory is a facility where trained personnel using appropriate equipment can evaluate objectively the effects of diseases on the respiratory system. Spirometry, introduced to clinical medicine by Hutchison in 1846, is still the most useful test in the evaluation of pulmonary function. Following extensive research in respiratory physiology, several other tests have been developed to further analyse the disordered respiratory system. Through these procedures, one may assess arterial blood gas values, lung volumes, pulmonary diffusion capacity, exercise tolerance, bronchial responsiveness, lung elasticity, control of breathing and respiration during sleep. The technical terms used in these guidelines are defined in the glossary which follows.

Pulmonary function testing provides helpful information in a great variety of clinical problems:

- diagnosis of obstructive or restrictive lung disease,
- periodic monitoring of the effects of treatment in patients with obstructive, restrictive or pulmonary vascular diseases,
- medical surveillance of workers exposed to noxious dusts, gases or fumes,
- assessment of respiratory functional impairment,
- preoperative evaluation.

Pulmonary function tests are not restricted to one type of institution. Some may be appropriately performed in locations such as physicians' offices and industrial clinics. Others are best restricted to hospital laboratories and regional health centres.

All pulmonary function laboratories need not offer a complete set of the available tests. The choice of equipment and tests will vary according to the type of population served and the institution in which the laboratory is located.

GLOSSARY

1. Spirometer: a mechanical or electronic device which can record volume changes.
2. Spirometry: measurement of vital capacity and flow rates during forced expiration. Simple spirometry involves measurement of forced vital capacity and $FEV_{1.0}$ (see below, 11)
3. Helium dilution: a technique for measurement of functional residual capacity using dilution of helium in a closed-circuit spirometer.
4. Body plethysmograph: a rigid chamber, in which the subject is enclosed, used to measure lung volumes and airways resistance.
5. Diffusion capacity for carbon monoxide (DCL_O): capacity of the lung to transfer carbon monoxide from alveolar gas to capillary blood.
6. Blood gases: measurements of pH and partial pressures of oxygen and carbon dioxide in arterial or central venous blood, usually by using special electrodes.
7. Flow-volume curve: a graph recording maximal expiratory and inspiratory flow rates against lung volume (forced vital capacity).
8. Bronchial provocation test: a measure of the response of airways to inhalation of graded amounts of an agent used to elicit bronchoconstriction.
9. Lung mechanics: a group of complex procedures used to assess the mechanical properties of the respiratory system. Lung compliance and airway resistance are the most commonly measured parameters.

10. Lung volumes:- total lung capacity (TLC): lung volume at the end of a maximal inspiration
 - vital capacity (VC): maximum volume of gas expired after a full inspiration
 - forced vital capacity (FVC): maximum volume of gas expired after a full inspiration using maximum effort during expiration
 - functional residual capacity (FRC): lung volume at the end of a normal expiration
 - residual volume (RV): volume of gas remaining in lung after a maximal expiration.
11. Expiratory flow rates: - forced expiratory volume in 1.0 second (FEV_{1.0}): volume of gas expired in the first second of a forced vital capacity
 - maximal mid-expiratory flow (MMEF-FEF 25-75): mean expiratory flow measured between 25% and 75% of a forced vital capacity.
12. Gas distribution: method of assessing the evenness of the distribution of inspired gas within the lung.
13. Physical calibration: calibration using standard reference devices such as syringes for volume, water manometers for pressure and rotameters for flow.

14. Calibration: systematic standardization of the gradation of a quantitative measuring instrument, by the use of a reference scale.
15. Quality control: standardized procedure to test the accuracy and precision of the calibration as well as possible artifacts that may develop during operation of a given device.
16. Sleep studies: Measurements of ventilation and arterial blood gases made while the subject is asleep, usually documented by electroencephalography.
17. Residual standard deviation: defined in appendix II where used.

GUIDELINES

1. APPLICATION OF PULMONARY FUNCTION EVALUATION

Arterial blood gases. Any hospital with an emergency department and intensive care unit which cares for medical or surgical patients who are seriously ill should have arterial blood gas measurement available, providing adequate skilled staffing and quality control are also available. Arterial blood gases should not be performed outside the hospital setting.

Simple spirometry. Measurement of $FEV_{1.0}$ and FVC may be useful in any patient suspected of having pulmonary disease on the basis of clinical symptoms or risk factors (smoking, occupation). If the $FEV_{1.0}$ or $FEV_{1.0}/FVC$ are decreased on the initial test, a repeat test after inhalation of a bronchodilator is indicated. Serial measurements are indicated in patients, such as asthmatics, whose functional status may change rapidly. Facilities for these measurements are appropriate to any setting in which patients with lung disease are seen - doctors' offices, emergency units, small hospitals, etc. When adequately trained, a wide variety of health professionals are capable of conducting the tests - technicians, nurses, physicians. Simple equipment, utilizing physical measurements of volume and time are recommended, as opposed to electronic systems.

Measurement of $FEV_{1.0}$ and FVC can be justified in screening, for specific purposes, specific populations such as workers in high risk occupations. Screening of asymptomatic or random populations, such as people in shopping centres, is not a clinically useful procedure.

Lung function batteries of tests. Such batteries may include spirometry with measurements other than $FEV_{1.0}$ and FVC, measurements of lung volume, gas distribution and diffusion capacity, and progressive exercise tests with monitoring of heart rate, ventilation, and at times, arterial O_2 . Except for

exercise studies, these tests are done together frequently because it is often difficult to interpret the results of one in the absence of the others. Indications for such batteries are difficult to define, and the following examples are not meant to be comprehensive. Batteries are indicated when lung disease is strongly suspected and when the results of simple spirometry are normal or equivocal. They are indicated for assessment of patients with restrictive lung disease and in individuals with more than one disease, e.g. patients considered for resective cancer surgery with symptomatic obstructive disease and patients undergoing complicated cancer chemotherapy. Most patients with obstructive lung disease can be assessed and managed without these batteries, as simple spirometry is sufficient. These tests should not be used for screening purposes.

Successful use of these tests demands rigorous quality control, full time technical staff and substantial physician input; for example, a physician should be present during exercise testing. Facilities for such tests should be limited to institutions which have more than one fully qualified physician available for quality control and interpretation of results.

Special tests. These include studies of sleep, lung mechanics, control of ventilation, more complex exercise tests and studies involving the induction of bronchoconstriction. They are difficult to perform, have few indications and in some instances are associated with recognizable risk. Given the restricted indications for these tests, it is unlikely that centres can, on the basis of pure clinical testing, maintain a case load adequate to assure staff expertise and quality control. For this reason these tests should be offered for clinical purposes only in centres which also employ them for other purposes, usually research.

2. BED REQUIREMENTS

None. These tests may be done on an out-patient basis.

3. MINIMUM PATIENT LOAD

There is no base load for spirometry. Arterial blood gases should be available based on general need in the management of seriously ill patients. To justify the expense of acquiring, maintaining and staffing facilities for lung function batteries, such facilities should be available only in regional centres or combinations of centres serving a population of 250,000, (given that the facilities are appropriately used) and serviced by 2-3 specialists in lung disease.

Special tests (identified above) should be available only in major teaching hospitals dealing with patients referred from a population base of approximately 1,000,000, except where research or other factors may justify these tests.

4. ADMINISTRATIVE POLICY, PROCEDURES AND CONTROL

4.1 Medical Supervision

Measurements of pulmonary function, from the simple to the complex, should be made under the clinical supervision of a physician who has specific training in the application of those techniques to clinical medicine.

4.2 Administrative Supervision

There should be a designated member of hospital administration to provide administrative support to the unit medical director, including the areas of personnel, space and budget.

4.3 Secretarial Support

The institution in which the laboratory is situated must provide adequate secretarial support. The amount of such support will depend on the resources available to the laboratory, e.g. data processing, file storage, etc.

4.4 Policies and Procedures

Policies governing these services should be developed by the unit medical director. These policies should be approved by the Board of Trustees on the recommendation of the Medical Advisory Committee, and should include the following:

- Pulmonary function testing should only be provided on the order of the physician responsible for the patient.
- A report of the pulmonary function test performed, together with an interpretation, should be returned to the responsible physician and form part of the patient's record.
- Copies of all such reports, together with raw data, should be filed in the unit for an appropriate length of time.

4.5 Responsibilities of Staff

Medical Director

The medical director shall be responsible for:

- supervision of the technical staff in the pulmonary function laboratory
- the development of a procedure manual which conforms with standardized hospital procedure manuals and which details the methods of pulmonary function testing to be used in the laboratory, and which includes methods to be used for ongoing quality control
- the interpretation of results obtained from such tests
- ensuring the appropriateness of the test requested, having regard for the patient's safety and convenience as well as the cost and likelihood of obtaining useful results.

Technical Staff

The technical staff shall be responsible for:

- the accurate performance of the testing as outlined in the procedure manual
- the maintenance of the testing equipment and the ongoing quality control, both of the equipment as well as the testing procedures
- ensuring patient safety during the performance of the tests.

5. STAFF ESTABLISHMENT AND COVERAGE

The minimal staff requirements for a pulmonary function laboratory are a medical director and technologist. If the laboratory is to include the measurement of arterial blood gases, then provision must be made for this to be available on a twenty-four hour basis. Simple spirometry should also be available around the clock. The number of staff needed to provide such service will depend on workload, organization, automation of equipment and on the circumstances of the individual hospital.

Other measurements of pulmonary function, i.e. lung volumes, exercise, etc., can be scheduled in normal working hours. The number of staff available to do such tests will depend on the clinical load that is placed on the laboratory. Under ideal circumstances, patients should have to wait no longer than two weeks for such testing. The Unit System¹ is a technique that may be used to establish the efficiency of the scheduling of a laboratory. It is important that the unit values applied should be appropriate for the type of testing being done, e.g.

¹ Canadian Schedule of Unit Values for Clinical Laboratory Procedures - Statistics Canada.
Health Division, Ottawa

the unit value for out-patient spirometry is significantly different than that for bedside spirometry. Where such values do not exist as yet, the medical director shall have the responsibility for devising an appropriate value in accordance with the existing guidelines.

In laboratories where more than three technicians are required, it is advisable that there be a designated technician to assist the medical director in the administration of the laboratory.

6. STAFF QUALIFICATIONS AND TRAINING

6.1 Initial Qualifications

Medical

The director should hold certification from the Royal College of Physicians and Surgeons of Canada, la Corporation des médecins du Québec, or its equivalent, in a specialty such as Respiriology, Internal Medicine, Anesthesiology or Pediatrics. The individual must, in the course of his/her training, have received specific instruction in the techniques being employed in the laboratory so that the director is familiar, not only with the interpretation of the results, but also with the basic understanding of the principles used in their measurement.

Technical

At the present time there is no recognized program in pulmonary function technology from which all technologists must graduate in order to work in a pulmonary function laboratory. However, in order to perform any of these procedures adequately, an individual must receive training in an established laboratory that meets the standards of the provincial licensing body where applicable.

Guidelines² have been developed elsewhere which appear to be appropriate in Canada. In these standards, the minimal formal education is high school graduation with particular emphasis in the areas of mathematics and preferably, chemistry as well as physics. The individual should then undergo training in an established laboratory, the length of training depending on the tasks expected to be undertaken by that individual. For example, six months would be required to become competent in the measurement of arterial blood gases and a year for progressive exercise testing. The length of time to obtain such competency would be reduced by a programme in Respiratory Technology, by the study and examination process of the Canadian Society of Pulmonary and Cardiovascular Technologists or by a BSc in Human Physiology and Kinesiology.

Such background training, as well as a minimum of two years of laboratory experience, is necessary for a technician to be able to function in a supervisory capacity under medical direction.

6.2 Continuing Education

Medical

The medical director must keep abreast of the developments taking place in the field. This can be done usually through a combination of regular attendance at major respiratory meetings and ongoing review of pertinent medical literature.

Technical

Technicians should be encouraged to attend appropriate meetings regularly. Supervisory technicians in major laboratories should be encouraged to engage in continuing education pertinent to their field.

² "Personnel Standards, Pulmonary Function Laboratory Technical Staff," American Thoracic Society News, proposed Spring 1982.

7. SPECIFIC SUPPORTING DEPARTMENTS AND SERVICES

7.1 Regular Supporting Departments and Services

Biomedical Engineering

Biomedical engineering services are required for routine repairs and maintenance of equipment as well as for routine safety checks of electrical equipment.

Assistance from Biomedical Engineering should also be requested when new equipment is being considered for purchase. (Availability of this service from off site source will suffice).

Computer Services

For laboratories with computerized systems, support for both hardware repair and software maintenance is often necessary. If this support is not available through any department in the hospital, then outside assistance should be sought either through the company providing the equipment, or on a contract basis with private servicing firms.

Gas Supply

In institutions where supply of oxygen and compressed air and a vacuum source are not provided in wall outlets, it would be necessary to have these provided to the laboratory on a regular basis.

7.2 Supporting Departments and Services During a Medical Emergency

In laboratories doing exercise testing, emergency services should be available. All laboratories should have oral airways and ventilation equipment.

8. SPACE ALLOCATION, UTILIZATION AND SPECIAL DESIGN FEATURES¹

8.1 Introduction

The following space requirements will be modified by the relationship of the pulmonary function laboratories to departments of respiratory technology, cardiac non-invasive laboratories (ECG and stress test laboratories) and pulmonary rehabilitation programs.

Some modern equipment is highly sensitive to the ambient temperature making air-conditioning essential.

The following description assumes that gas sterilization and central supply facilities are located in other areas.

8.2 Area Designation

All areas in this section are designated in net square meters (net m²) or net square feet (net sq.ft.). This is the actual usable space within a room or area (inside wall to wall dimensions or to lines of functional separation). The figures refer to the quoted minimum space requirements.

The major components of a pulmonary function laboratory consist of:

- Primary Activity Areas (work testing stations)

This includes the area for patients, equipment, technician(s), and work space for the performance of a specific test or procedure.

¹ Evaluation and Space Programming Methodology series. Volume 12, Respiratory Technology Pulmonary Function, May 1979, Health and Welfare Canada.

- Support Areas
- Administrative Space

8.2.1 Primary Activity Areas

- Spirometry (Measurement of FVC, FEV₁ before and after bronchodilators): area 5.6 net m² or 60 net sq. ft.
- Arterial blood gases (Measurement of PO₂, PCO₂, pH by automated equipment and storage of standard gases): area 5.6 net m² or 60 net sq. ft.
- Flow volume curves (using semi-automated equipment before and after bronchodilators): area 5.6 net m² or 60 net sq. ft.
- Lung volumes
 - Helium lung volumes require: area 5.6 net m² or 60 net sq. ft.
- Plethysmography: including measurement of airway resistance before and after bronchodilators will require: area 9.3 net m² or 100 net sq. ft.
- Diffusion capacity

Diffusion capacity, either by steady state or single breath technique with semi-automated equipment: area 5.6 net m² or 60 net sq. ft.

(In some laboratories this is often performed using the same apparatus as helium lung volumes).

- Progressive exercise testing

Includes space for monitoring and resuscitative equipment used and change and rest areas for patients: area 9.3 net m² or 100 net sq. ft. plus the following area for each type of equipment: treadmill 4.7 net m² or 50 net sq. ft., each

bicycle ergometer 2.8 net m² or 30 net sq. ft.,
two-step 2.8 net m² or 30 net sq. ft., tilt table
8.4 net m² or 80 net sq. ft.

In major hospitals where highly specialized tests are performed, additional space will be required for these laboratories.

8.2.2 Support Areas

- Waiting room for patients.*
area 11.1 net m² or 120 net sq. ft.
- Toilet facilities - patients.*
- Storage Space

The area for storage space is calculated at 0.25 x the total testing station space. For example, if testing stations for spirometry and blood gases are present (11.2 net m²) then the storage space would be, 11.2 x .25 = 2.8 net m² or 30 net sq. ft.

This space, when used for gas cylinders, must meet the requirements of the local fire code.

- Clean-up Space

Includes double stainless steel sink and counter space: area 2.8 net m² or 30 net sq. ft.

- Janitor's Closet*
area 2.8 net m² or 30 net sq. ft.

* These facilities depend upon the relationship of the unit to other units, its overall size, and the number of personnel employed in it, as well as hospital policy regarding centralization of support staff space and patient waiting areas.

8.2.3 Administrative Space

The need for administrative space would normally apply only to regional and larger centres.

- Medical director's office - pulmonary function laboratory: area 11.1 net m² or 120 net sq. ft.
- Supervisory technician's office - pulmonary function laboratory: area 9.3 net m² or 100 net sq. ft.
- Clerical and record storage facilities: area 9.3 net m² or 100 net sq. ft.
- Conference room*
- Staff lockers, toilet, lounge facilities*

9. EQUIPMENT

Routine tests

When choosing the type of equipment, accuracy of the measurements is paramount. The workload and economic considerations are also important as are ease of use, servicing, etc.

9.1 Arterial blood gases

In general, the hospital with a very high volume will usually find it more economical to use self-calibrating machines, although at least one manual machine should be available in teaching institutions. Those

* These facilities depend upon the relationship of the unit to other units, its overall size, and the number of personnel employed in it, as well as hospital policy regarding centralization of support staff space.

with moderate workloads might find it most economical to use manual or semi-automated machines. It is suggested that low volume laboratories with infrequent requests for blood gases should invest in a self-calibrating system. Although costly, it at least ensures that the "stat" blood gas can be analyzed immediately. As errors in measurement can be life threatening, stringent controls are essential. (See Appendix 1).

An apparatus for the independent measurement of oxygen saturation may be useful, especially if blood gas measurements are used in the assessment of hemodynamics.

9.2 Spirometry

Simple spirometry requires a device capable of the measurement of vital capacity (VC), forced vital capacity (FVC) and forced expired volume in 1 second ($FEV_{1.0}$). The simple spirometer uses physical measurements of volume and time and produces a graphic record of volume versus time. Spirometers should meet the criteria set forth by the Snowbird Conference¹.

9.3 Flow volume curves

Flow volume curves require the use of equipment capable of recording measurements of flow and volume simultaneously. Flow should be plotted against volume on an X-Y recorder or oscilloscope and a permanent record made. Laboratories performing these tests require the ability to perform inspiratory as well as expiratory curves.

¹ Spirometers in this category should meet ATS standards. See "American Thoracic Society Statement - Snowbird Workshop on Standardization of Spirometry" - American Review Respiratory Disease, Vol. 119, 1979

9.4 Lung volumes

Lung volumes can be measured utilizing dilution techniques or plethysmography:

Dilution techniques:

- Closed circuit helium dilution technique. Requires a nine litre capacity recording spirometer complete with carbon dioxide absorber with mixing device and with chart speeds of 60 millimeters per minute and 1200 millimeters per minute and a helium analyzer.
- Open-circuit nitrogen washout technique. Requires a nitrogen analyzer and a method of volume measurement over a prolonged period of time (Douglas bag or Tissot gas meter or integrated pneumotachograph signal).

Plethysmographic technique

This is usually done in combination with measurement of airway resistance. The plethysmograph is made of rigid walls, with approximately 600 litre capacity. The best type for clinical use is a constant volume body plethysmograph and the attachments include pneumotachograph, mouth shutter, pressure transducers, solenoid valves, preamplifiers and either an oscilloscope or a rapid X-Y recorder. These are commercially available as packages. Home made packages are not recommended as service is usually difficult.

9.5 Diffusion capacity

The single breath method is recommended for the routine determination of diffusion capacity. The steady state procedure is, however, an alternative. Required elements include: a carbon monoxide analyzer, a helium analyzer and a volume measuring device with recorder and appropriate valve system.

Modern pulmonary function testing equipment is available in packaged modules combining capabilities for the measurement of spirometry, flow volume curves, lung volume and diffusing capacity. These modules are acceptable providing they can be subjected to quality control as outlined in Appendix 1.

9.6 Progressive exercise testing

This equipment must be capable of continuous and accurate monitoring of the patient's heart rate and rhythm, ventilation and if possible, oxygen saturation. Requirements are:

- 1) an electronic or mechanical bicycle ergometer or a treadmill with a speed of 0 to 16 km/h and a grade range of 0° to 20° elevation
- 2) a technique for measuring ventilation, e.g. dry gas meter, Tissot spirometer or integrated pneumotachograph
- 3) a direct writing ECG machine
- 4) an ear oximeter if measurements of oxygen saturation are made.

9.7 Special tests

Provocation testing, studies of pulmonary mechanics, control of breathing, sleep and steady state exercise are highly specialized tests appropriate to major teaching hospitals, and equipment used will vary according to the specific measurements being made.

10. PHYSICAL RELATIONSHIP WITH OTHER DEPARTMENTS

There must be flexibility in the design of these units. In many hospitals there will be shared spaces for certain facilities. For example, in some hospitals the work space for blood gas determinations might be

part of a clinical chemistry department. In some facilities exercise testing may co-exist with a cardiac stress testing laboratory. In other facilities it may co-exist with physiotherapy or rehabilitation services, or it may be part of the pulmonary function laboratory. Facilities having exercise testing require space for a medical supervisor.

Since most pulmonary function tests are performed on ambulatory patients, many of whom are disabled by poor exercise tolerance, easy access to main entrances, parking and elevators is essential in the location of these facilities.

CALIBRATION AND QUALITY CONTROL OF THE PULMONARY FUNCTION LABORATORY

Appropriate quality control procedures and equipment are an essential component of any pulmonary function laboratory. Each laboratory must purchase and maintain the equipment necessary to perform routine calibration checks of all testing equipment and set aside non-patient time for equipment calibration. Basic physical calibration equipment should be employed and equipment involving electronic signals avoided. When electronic calibration is utilized, it must be checked against physical calibration regularly.

Following the calibration of equipment, normal individuals may be utilized to verify the overall performance of the equipment, keeping in mind the reproducibility of the test within a given individual. With more complex tests involving multicomponent systems, normal subjects should be employed more frequently.

Each calibration procedure should be repeated at least twice to ensure reproducibility. Results (raw data) should be labelled, dated, and filed. Calibration procedures should be done at least monthly, or whenever accuracy is in doubt.

1. Blood gas analysis

Quality control procedures in the blood gas area can vary somewhat according to type of equipment and number of machines operating simultaneously.

The workload of the laboratory should be taken into consideration when choosing the type of system to use. In general, the hospital with a high volume will find it more economical to use self calibrating machines, although at least one manual machine should be available in teaching institutions.

Those with moderate workloads might find it most economical to use manual or semi-automated machines. It is suggested that low volume laboratories with infrequent requests for blood gases should invest in a self-calibrating system. Although costly, it at least ensures that the "stat" blood gas can be analyzed immediately and accurately.

As errors in measurement can be life threatening, stringent controls are essential. The following is recommended as the minimum quality control:

A. Manual systems

- i) One two-point calibration per day, with buffers of high and low pH, and gases with known P_{CO_2} and P_{O_2} (some machines may need one two-point calibration per shift, rather than per day).
- ii) Before each measurement, a one-point calibration must be done. Each blood sample must be put through the machine twice, to ensure reproducibility. If two machines are running simultaneously, it is advisable to put one sample through each of two machines.
- iii) Quality control must be done at least once a day, and once a shift if necessary.

O₂ and CO₂ Electrodes

The best and most economical quality control available at the moment is the use of tonometered blood at 3 levels of P_{O_2} and P_{CO_2} . This technique, however, requires considerable technical sophistication and should only be utilized in laboratories employing full-time blood gas technologists who have been trained in tonometry.

For those laboratories which cannot utilize tonometry, commercially pre-packaged quality control products are available. They include non-temperature dependent red blood cell

suspensions or aqueous, buffer based materials. In this situation, 3 vials of material with high, intermediate, and low levels of Po_2 and Pco_2 must be used.

pH Electrodes

Calibration and quality control procedures are similar; certified buffers at two pH levels being required. Regardless of the type of quality control chosen for Po_2 and Pco_2 , when more than one blood gas machine is in operation, all quality control samples should be run through all machines, and the results compared.

- iv) Preventive maintenance should be done once per day and results documented (i.e. temperature checks, membrane checks, etc.)

B. Self Calibrating Systems

- i) Each blood sample must be put through the machine twice, to insure reproducibility. If two machines are running simultaneously, it is advisable to put one sample through each of the two machines.
- ii) Quality control - same as A iii
- iii) Preventive maintenance - same as A iv

C. Blood Gases on an Infrequent Basis

For the smaller hospital laboratory or a satellite operation of a larger laboratory where the blood gas machine is not used constantly, a self-calibrating system which recycles at least every 2 hours is recommended. Any system (manual or self-calibrating) must have a two point calibration and quality control procedures performed once a day.

In such laboratories, tonometry is not a reasonable quality control procedure. Alternatives have been discussed in paragraph A) iii.

2. Volume measuring devices¹

The accuracy of the device must be checked using a super syringe of at least one liter capacity. The linearity must also be checked over the whole range of use of the instrument. At each calibration, the instrument should be checked for leaks.

Note: Accuracy of a new super syringe should be checked against a large volumetric flask using a water displacement method.

For bedside or office spirometry, devices which measure time and volume rather than flow are advised due to the increased complexity and cost of flow calibrating equipment.

3. Timing mechanisms¹

Any device which provides a calculation of time (i.e. some spirometers) must be checked for accuracy. Most timing systems can be checked by generating the signal in question over an extended period of time which is then measured by a stop watch.

The electronic FEV_{1.0} timer on flow volume systems can be checked with the use of an oscilloscope and should be looked at by biomedical engineering personnel at least yearly.

4. Flow measuring devices¹

The accuracy and linearity of these devices should be checked by drawing various known flows through them. Usually, if the equipment is used to measure

¹ Spirometers in this category should meet ATS standards. See "ATS Statement - Snowbird Workshop on Standardization of Spirometry" - American Review on Respiratory Disease Vol. 119 1979

both low, (less than 2 L/sec) and high (more than 2 L/sec) flow rates, two rotometers (0-2 L/sec and 2-20 L/sec) should be used in conjunction with a vacuum cleaner to draw flow through the system (air should not be blown through the rotameter, as the motor can generate heat and rotameters are factory calibrated under ATPS conditions).

Note: At the time of purchase, rotameter should be calibrated against the volume displacement of a large Tissot spirometer (at least 120 liters) over the longest possible period of time as measured with a stop watch. A calibration curve should be drawn, and used to correct rotameter readings.

Devices which produce a constant spirogram or flow volume tracing do not replace physical calibration procedures but might be considered for use in place of checks with normal individuals.

5. Pressure measuring devices

The accuracy of the device should be calibrated using a water or mercury manometer. The linearity of the instrument must also be checked over its whole range of use. (At least a 3-point calibration).

6. Gas analyzers

Whenever absolute gas concentrations are required (for example, in the measurement of CO_2 for CO_2 response curves), a calibration curve must be constructed for the analyzer in question. Calibration curves supplied by manufacturers must be verified at the time of delivery and every month thereafter, or when accuracy is in doubt.

Calibration curves should be constructed using a series of gas tanks with different concentrations of the test gas. One tank (gravimetric analysis) is used to set the analyzer, and the other gas concentrations (standard analysis) to build a curve.

Points on the curve should cover the whole operational range of the analyzer and the values of the tank gas used to correct the meter readings if necessary.

Since carbon dioxide and infra-red carbon monoxide analyzers are intrinsically non-linear, at least a 5-point calibration curve is necessary to check and/or adjust the electronics which make them linear, or to build a calibration curve. As nitrogen, oxygen, helium and chemical carbon dioxide analyzers are linear, only a 3-point calibration is necessary.

Whenever an analyzer is sensitive to a gas other than the test gas, the background concentration of the other gas must be kept constant. (e.g. if one wishes to calibrate a helium analyzer which is also marginally sensitive to oxygen, any test gas mixtures which have varying concentrations of helium should have a fixed concentration of oxygen).

In test procedures where the absolute gas concentration is not required because one is measuring a ratio of gas concentration, (e.g. when using He and CO analyzers to measure the diffusing capacity of the lung) it is sufficient to check the linearity of the analyzer by systemically diluting a 100% concentration of the test gas with room air (5 dilutions) throughout the range of the analyzer.

Note: While minor parallel shifts in the calibration curve are not important when only the ratio value is being considered, changes in slope of the curve from one occasion to another usually is the result of an alteration in sensitivity of the analyzer.

7. Plethysmographs

A. Variable Pressure

The box pressure on this instrument should be calibrated with a pump delivering between 30-100 mls. at a frequency which should be the same as the panting frequency (usually 2 cycles/sec.) used in the test procedures.

Flow and mouth pressure should be calibrated as described above in sections 4 and 5.

B. Variable Volume

When used to measure airways resistance, the box volume should be calibrated as in 7 A.

Flow and mouth pressure should be calibrated as described above in sections 4 and 5.

Note: The use of this type of plethysmograph should be limited to special procedures as its operation is much more complex than the variable pressure plethysmograph which is usually sold in a pre-set package.

8. Cycle ergometer

A. Electronic cycles

The zero and a fixed position on the workload indicator should be checked for proper electronic output values. This should be done at least twice a year. Annually, the physical calibration should also be checked, using, for example, a torque calibrator.

B. Mechanical cycles

Several workloads should be tested using at least three known weights for accuracy. This should be done at least twice a year.

9. Treadmill

Speed of the belt and the inclination indicator should be checked at least twice a year.

REFERENCE VALUES

Once lung function has been measured, it is quite customary to compare the results with reference values. The purpose of such a comparison is to help in arriving at a diagnosis of normality or abnormality.

There is a great number of predicted values to choose from. Unfortunately, the variability among them is very large, making the choice of "normal values" difficult, since there is no objective means of singling out one set of data as being superior to the others.

When a laboratory chooses a set of reference values, the following recommendations should be taken into account.

1. Studies with the largest number of tests are preferable. Technological comparability among different tests is high when performed in the same laboratory and low among different laboratories.
2. There should be, as much as possible, similarity between the equipment and techniques used in the laboratory and that used to obtain reference values.
3. There should be a large number of subjects of both sexes and in all age groups.
4. The age range of the population should be extensive, including groups well into the extremes of age.
5. A wide range of the population is best described by at least two linear regressions (increasing function up to age 22-30, decreasing function to

age 80) and still better with three regressions (increasing, plateau and decreasing) or a single parabolic equation.

6. The population samples should be heterogeneous, going across socio-economic status. Surveys should be of communities or towns, not of professional groups. Homogeneous groups - religious groups, miners, subjects in sanatoria, etc., should be avoided, unless a special purpose population is sought.
7. Ethnic factors, smoking habits and respiratory symptoms should be accounted for in an accepted standardized fashion.

Ideally, the choice of reference values should be based on the comparison of data obtained from a reasonable sample of "normal" subjects, with data from the literature. The reference value best suited to the "normal" population is then chosen. This reference is not necessary for tests such as FVC, FEV, VC, RV, FRC, since the standard deviations within and among studies are, in general, small.

Tests with large within and among study variations, such as PEF, FEF and DLCO should probably be validated in each laboratory, with a population of at least 30 normal subjects, chosen as outlined above.

The following references fit most of the outlined recommendations, and are widely used throughout North American laboratories. Residual Standard deviations are included for each test. It should be emphasized that results falling within two standard deviations of the predicted value, should still be considered normal.

Since all of the predicted formulas are based on whites, correction factors should be used for non-whites. Correction factors are included below.

**LUNG FUNCTIONS: SCALE FACTORS¹
FOR POPULATION GROUPS APPLIED TO
PREDICTIONS**

Race	FVC and FEV ₁	MMEF	Diffusion Capacity
White	1.000	1.000	1.000
Black	.885 ²	1.020 ²	.925 ³
Chinese	.900 ⁴	1.020 ⁴	.925 ³
East Indian	.813 ⁵	1.020 ⁵	.925 ³

¹ refers to males only

² Rosssiter & Well, Int. J. Epid: 33:55, 1974

³ Schoenberg et al, Resp. Physiol.: 33:367, 1978

⁴ Ching & Horsfall, Thorax: 32:357, 1977

⁵ Miller et al. ARRD: 102:979, 1970

Courtesy of Dr. M. R. Becklake

REFERENCE VALUES

FVC Reference	Sex	Regression Equations ¹	Residual ² Standard Deviation RSD	Approximate Normal Variation
Bass (wedge spirometer)	Male Female	5.91H ³ - 0.021A ⁴ - 5.31 3.07H - 0.015A - 1.31	0.60 0.36	20%
Cherniak (wedge spirometer)	M F	4.76H - 0.014A - 3.18 3.08H - 0.015A - 1.05		
Crapo (wet spirometer)	M F	0.0600H - 0.0214A - 4.650 0.0491H - 0.0216A - 3.590	1.115* 0.676*	
Dickman (wet spirometer)	M F	4.88H - 0.028A - 2.967 4.84H - 0.013A - 4.137	0.46 0.36	
Knudson (pneumotachograph)	M F	6.5H - 0.029A - 5.46 3.7H - 0.022A - 1.77	0.60 0.52	
Morris (wet spirometer)	M F	5.83H - 0.025A - 4.24 4.53H - 0.024A - 2.85	0.74 0.52	
Higgins				
7 - 15 years	M	- 6.394 + .114A + .052H		
16 - 19 "	M	- 6.993 + .114A + .057H		
20 - 74 "	M	- 5.38 - .024A + .062H		
10 - 15 years	F	- 4.377 + .106A + .037H		
16 - 19 "	F	- 4.301 + .063A + .040H		
20 - 74 "	F	- 2.171 - .018A + .037H		

- 1) All reference equations refer to adults (greater than 25 years of age), whereas Higgins refer to both adults and children. For further data in pediatric populations, the reader is referred to: Pulgard G. and Fromadhad V.: Pulmonary Function Testing in Children. Techniques and Standards Saunders 1971
 - 2) Residual Standard Deviation: Standard deviation of the estimate. When a result is beyond two standard deviations from the estimate the test could almost invariably be considered to be abnormal. (see text)
- H - Height in cm. If height cannot be measured, arm span is the best approximation.
- A - Age in years

Reference	Sex	Regression Equations	RSD	Variation	
FEV ₁					
Cherniak	M	3.59H - 0.023A - 1.51		20%	
	F	2.37H - 0.019A - 0.19			
Crapo	M	0.0414H - 0.0244A - 2.190	0.842*		
	F	0.0342H - 0.0255A - 0.578	0.561*		
Dickman	M	3.70H - 0.031A - 1.501	0.39		
	F	3.62H - 0.014A - 2.571	0.28		
Knudson	M	5.2H - 0.027A - 4.2	0.54		
	F	2.7H - 0.021A - 0.79	0.43		
Morris	M	3.62H - 0.32A - 1.26	0.55		
	F	3.5H - 0.025A - 1.93	0.47		
Higgins					
7 - 15 years	M	- 5.315 + .108A + 0.43H			
16 - 19 "	M	- 4.926 + .077A + 0.045H			
20 - 74 "	M	- 3.18 - .028A + .046H			
10 - 15 years	F	- 3.725 + .101A + .032H			
16 - 19 "	F	- 4.19 + .060A + .038H			
20 - 74 "	F	- 1.066 - .021A + .028H			
FEV ₁ /FVC					
Crapo	M	- 0.1300H - 0.152A 110.49	8.28*	20%	
	F	- 0.2020H - 0.252A 126.58	9.06*		
Knudson	M	- 8.7H - 0.14A 103.64	6.72		
	F	- 11.1H - 0.109A 107.38	7.66		
Morris	M	107.12 - 0.3118H - 0.2422A	7.79		
	F	88.70 - 0.0679H - 0.1815A	6.84		
Higgins					
7 - 15 years	M	101.738 - .077H			
16 - 19 "	M	87.78 - constant			
20 - 74 "	M	113.352 - .181A - .128H			
10 - 15 years	F	102.794 - .070H			
16 - 19 "	F	92.71 - constant			
20 - 74 "	F	111.501 - .204A - .109H			
FEF ₂₅₋₇₅					
Cherniak	M	2.34H - 0.037A 2.61		50%	
	F	1.94H - 0.031A - 2.26			
Crapo	M	0.0204H - 0.0380A -2.133	1.666*		
	F	0.0154H - 0.0460A - 2.683	1.363*		
Dickman	M	2.80H - 0.021A - 0.035	0.63		
	F	2.24H - 0.036A - 2.143	0.91		
Knudson	M	4.5H - 0.031A - 1.86	1.16		
	F	2.1H - 0.024A - 1.17	0.99		
Morris	M	1.85H - 0.045A - 2.51	1.12		
	F	2.36H - 0.03A - 0.55	0.88		

Reference	Sex	Regression Equations	RSD	Variation
Higgins				
7 - 15 years	M	- 4.482 .145A .038H		50%
16 - 19 "	M	- 1.792 .037H		
20 - 74 "	M	- 1.890 - .044A .022H		
10 - 15 years	F	- 2.636 .125A .028H		
16 - 19 "	F	- 1.213 .032H		
20 - 74 "	F	1.616 - .034A .018H		
PEF				
Cherniak				
	M	5.67H - 0.024A 0.23		2.08
	F	3.59H - 0.018A 1.13		
Knudson	M	9.4H - 0.035A - 5.993		
	F	4.9h - 0.025A - 0.735	1.61	
Higgins				
7 - 15 years	M	- 7.735 .239A .063H		50%
16 - 19 "	M	- 6.889 .283A .057H		
20 - 74 "	M	- 1.616 - .036A .065H		
10 - 15 years	F	- 4.418 .221A .041H		
16 - 19 "	F	- 7.183 .198A .058H		
20 - 74 "	F	.726 - .020A .034H		
VC				
Goldman				
	M	6.4H - 0.031A - 5.335	11%	13%
	F	5.2H - 0.018A - 4.36		
TLC				
Goldman				
	M	9.4H - 0.015A - 9.17	10%	11%
	F	7.9H - 0.008A - 7.49		
RV				
Goldman				
	M	2.7H 0.017A 3.45	19%	24%
	F	3.2H 0.009A 3.9		
FRC				
Goldman				
	M	8.1H - 1.792BSA - 7.11	17%	17%
	F	5.3H - 0.017W - 4.74		

Reference	Sex	Regression Equations	RSD	Variation
SB DLCO (ml/min mmHg)				
Cotes	M	$32.6H - 0.2A - 17.6$		25%
	F	$21.23H - 0.144A - 8.36$		
Crapo	M	$0.416H - 0.219A - 26.34$	8.2	
	F	$0.256H - 0.144A - 8.36$	6.0	
Gaensler	M	$3.75VA^b - 0.153A - 19.93$		
	F	$5.38VA - 0.083A - 7.72$		

GUIDELINES FOR POLICIES AND PROCEDURES FOR SPECIAL SERVICES IN HOSPITALS

Guidelines for policies and procedures for special services in hospitals were formulated after a review of provincial, national and international information.

It is hoped that the following outline will serve as a guide for the development of more comprehensive and specific Special Services policies in order to ensure the most effective and efficient delivery of patient care in these units.

I. ROLE AND OBJECTIVES

- Role and objectives of service in hospitals
- Type of patients served
- By diagnosis and/or severity of illness
- Restriction of service, if any (e.g. terminally ill patients)
- Services provided

II. ORGANIZATION OF SERVICE

- Governing Board responsibility
- Relationship to Administrator and Medical Staff
- Service management
- (i) Specific responsibilities of staff
 - Medical Director
 - Other medical staff

- Nursing staff
- Other staff

(ii) Committee

- Membership to be defined by discipline and number
- Terms of reference to be defined
- Provision for consultation with appropriate hospital and medical staff
- Schedules for formal and ad hoc meetings

III. POLICIES FOR OPERATION OF SERVICE

1. Admission authority by:

- Medical Director
- Assistant and resident physicians
- Nursing supervisor of service

2. Admission priorities by:

- Diagnostic category
- Clinical condition

3. Routine admission Standing Orders

4. Emergency admission Standing Orders

5. Length of stay by diagnosis

6. Guidelines for transfer based on specific routine and emergency priorities

7. Guidelines for discharge based on specific routine and emergency priorities

8. Educational requirements of staff
9. Provision for continuing education of staff
10. Establishment and maintenance of appropriate patient records
11. Emergency delegation of responsibility to medical, nursing and/or other staff
12. Equipment maintenance and safety
13. Continuing evaluation of effectiveness of service

IV. PROCEDURES

1. Elective procedures: medical, nursing and other
2. Emergency alert system procedures
3. Medical record and statistical procedures
4. Patient - visitor regulations

**GUIDELINES FOR
SPECIAL SERVICES IN HOSPITALS**

The following guidelines have been prepared by the federal-provincial Sub-Committee on Special Services in Hospitals. These guidelines were requested by the Federal-Provincial Advisory Committee on Institutional and Medical Care Services. Some of the guidelines are updated versions of guidelines previously published by the Sub-Committee.

Adult Psychiatric Services Provided by General Hospitals

Burn Unit

Cardiovascular Services in Hospitals

Ambulatory Electrocardiography Monitoring

Cardiac Care

Cardiac Catheterization

Cardiac Surgery

Cardiovascular Nuclear Medicine

Cardiac Pacemaker

Cardiac Stress Testing

Echocardiography

Intermediate Cardiac Care

Non-Invasive Vascular Laboratories

Phonocardiography

Child and Adolescent Psychiatric Services Provided by General Hospitals

Child and Adolescent Services in General Hospitals

Computed Tomography

Day Surgery Unit

Dental Care Units in Hospitals

Detoxication Unit

Diabetic Day Care Unit

Diagnostic Ultrasound Facilities in Hospitals

Emergency Services in Hospitals

Geriatric Day Hospitals

Geriatric Unit in a Hospital

Intensive Care Unit
Long Term Adult Institutional Care
Narcotic Addiction Treatment Unit
Nuclear Medicine in Hospitals
Palliative Care Services in Hospitals
Patient Hostel Unit
Perinatal Intensive Care Unit
Regional Renal Failure Program
Rehabilitation Medicine Unit
Respiratory Technology Service/Unit
Spinal Cord Injury Unit
Stroke Services
Total Parenteral Nutrition